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Title of Proposed Observation:

Coordinated Observations with the MinXSS Cubesat and SDO/EVE calibration rocket launch

Main Objective:

Perform EIS cross calibration with rocket SDO-EVE spectra and XRT cross calibration with MinXSS cubesat spectra.

Scientific Justification:

SDO-EVE rocket calibration flights are unique opportunities to calibrate the satellite version of SDO-EVE, provide MEGS A measurements from 6 – 37 nm, supply SAM 0.1 – 7 nm integrated solar images and are needed to cross-calibrate Hinode EIS. Monitoring the evolution of the EIS calibration is essential for many science objectives, including full sun raster mosaic images that can be used to create full sun DEMs. These EIS UV derived DEMs can be used to synthesize the solar emission at other wavelengths like X-rays.

The first Miniature X-ray Solar Spectrometer (MinXSS) cubesat will be deploying on in early April, 2016 and will provide the capabilities for spectrally resolved soft X-ray measurements.

Simultaneous observations with Hinode XRT filters will be used to cross-calibrate the two instruments. Combined MinXSS and Hinode XRT data will be used to explore short term active region evolution (days -> weeks), long term solar x-ray variability (month -> years), give insight on the potential presence of hotter, ($T > 6$ MK) dimmer ($EM < 10^{27}$ cm⁻⁵) plasma in active regions and chemical abundance variations.

Finally, the EIS 40" slot full sun raster mosaic data at ~0.1 nm resolution will provide unique images of relatively well isolated spectral lines. These spectral line images allow for direct assessment of the coronal structure at different temperatures, elements and ionization states. These EIS mosaic and XRT images will be used in analyzing the validity of different coronal heating mechanisms in numerical simulations.

Coordinated XRT and MinXSS measurements a few days (2 – 3) before, on (XRT and EIS) and a few days after the SDO-EVE launch day will supply a wealth of data to address numerous questions about the physics and current conditions of the corona.

In summary our objectives are:

1. Monitor the cross-calibration of EIS with SDO-EVE MEGS A (only available during rocket flights).
2. Cross-calibrate XRT with the MinXSS cubesat.
3. Construct EIS UV derived DEMs for comparison to MinXSS X-ray observations.
4. Perform a short term active region (or quiet sun if no ARs present) evolution study via x-rays.
5. Use EIS spectral line mosaic and XRT images to test the validity of coronal heating models in numerical simulations.

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SSC Point of Contact: EIS -- John Mariska (NRL)

Dates:

We desire three sets of XRT observations on three different days and two sets of EIS observations, preferably on the SDO-EVE launch day (tentatively scheduled for May 25, 2016 at 19:00:00 UT, we will confirm the launch date and time in May)

Top priority:

Measurements on the SDO-EVE rocket launch day. These measurements are:

1. Two sets (groups of exposure types, e.i. *short* + medium + long) of synoptic full sun XRT images with each filter (with the filters and exposure types stated in the XRT section) before the EIS full sun raster, approximately 13 hours before the launch window.
2. EIS full sun raster as stated in HOP 130 (duration ~ 4 hours). To occur approximately 12 hours before the launch window.
3. During the 1 hour launch window. Synoptic full sun XRT filter images (as stated in the XRT section). As many exposures as possible.
4. Repeat of #2, EIS full sun raster as stated in HOP 130 (duration ~ 4 hours). To occur approximately 12 hours after the launch window.
5. Repeat of #1, two sets (groups of exposure types, e.i. short + medium + long) of Synoptic full sun XRT images with each filter (with the filters and exposure types stated in the XRT section) after the EIS full sun raster (#4), approximately 17 hours after the launch window.

Secondary priority, to estimate active region (quiet sun) evolution:

A. 2 – 3 days before the SDO-EVE launch day, conduct two sets (groups of exposure types, e.i. short + medium + long) of synoptic full sun XRT images with each filter (with the filters and exposure types stated in the XRT section) two times for the selected day (early and later in the day)

B. 2 – 3 days After the SDO-EVE launch day, conduct two sets (groups of exposure types, e.i. short + medium + long) of synoptic full sun XRT images with each filter (with the filters and exposure types stated in the XRT section) two times for the selected day (early and later in the day)

Time window:

Short interruptions are OK for ten minute synoptic observations for all the observations stated in the previous section. It is desired that #2 and #4 are uninterrupted. Details are in the previous section.

For questions on the XRT requests please email Christopher Moore at Christopher.moore-1 at colorado.edu

For questions on the EIS request, please email Ignacio Ugarte-Urra at ignacio.ugarte-urra.ctr.sp@nrl.navy.mil

Target(s) of interest:

XRT OBSERVATIONS: Full sun images at sun center. No other targets of interest.

EIS OBSERVATIONS: See HOP 130

SOT Requests:

None

EIS Requests:

For details see HOP 130. A summary is below.

EIS study acronym: FULL_SUN_SLOT_SCAN_2

TARGET: Full Sun (multiple pointings)
EXPOSURE TIME: 20s
RASTER: Scanning
SLIT: 40"
FOV: 488"x512"
DATA COMP: JPEG85
DURATION: ~4h (5.75 min/exposure + pointing stabilization+SAA avoidance, 26 exposures)
DATA VOLUME: 364MB (14MBits/exposure, 26 exposures)
SPECTRAL WIND.: 13
LINES: He II 256.3, Si VII 275.3, Fe VIII 185.2, Fe XI 180.4, Si X 258.42, S X 264.2, Fe XII 195.1, Fe XIII 202.0, Fe XIII 203.8, Fe XIV 211.36, Fe XIV 274.24, Fe XV 284.1, Fe XVI 262.9

Pointing

- 15 spacecraft pointings covering full disk. Two EIS pointings per spacecraft pointing: top and bottom of CCD in order to maximize area and minimize spacecraft pointings.
 - This is a complex observation so for full details please check PDF file (hop_130_vX.X.pdf) at SolarSoft directory: \$SSW/hinode/eis/idl/atest/ugarte
- Email Ignacio Ugarte Urra at ignacio.ugarte-urra.ctr.sp@nrl.navy.mil with any specific questions.

XRT Requests:

We desire as many full sun (synoptic), sun centered images taking by XRT during the 1 – hour SDO-EVE rocket launch window (#3). Sets of images for #1, #5, A and B to be taken as stated in the DATES section We request the following filters below, in order to perform cross calibrations between the MinXSS cubesat and XRT.

- Al filters give estimations of spectral contributions mostly between 0.7 – 1.6 keV.

Medium_Al (short, medium and long exposures to increase dynamic range)

Thick_Al (*short if needed*, medium and long exposures to increase dynamic range)

- Medium_Be is critical!!!, ~28 μm thickness of the Beryllium window with the Si detector. This give a similar photon energy response to the MinXSS x-ray spectrometer response. Thus this is a critical filter for MinXSS – XRT cross calibration.

Thin_Be (short, medium and long exposures to increase dynamic range)

Medium_Be (short, medium and long exposures to increase dynamic range)

Thick_Be (long exposure time for a signal check)

-The Al_poly and Al_mesh are used for context images of the structure of the cooler solar atmosphere, for comparisons to SDO-AIA and for filter ratios.

Al_Poly (short, medium and long exposures to increase dynamic range)

Al_Mesh (short, medium and long exposures to increase dynamic range)

Dark – (3 exposures)

Bin all full sun images 2x2.

* = critical for MinXSS analysis please take as many as possible

IRIS Requests:

None

Additional instrument coordination:

None at this time. Possible NuSTAR coordinated observation.

Previous HOP information:

I have never submitted a Hinode XRT HOP before.

Additional Remarks:

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For EIS requests:

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Duration:

- ~16min at each pointing.
- ~4h total with no gaps.

Frequency: approx. every 2-3 weeks to monitor activity.

SAA-free period preferred to minimize duration and facilitate planning. Other periods are OK.